Exercise 7.1A

1 State the quantity described by these units.

a Newtons, N **b** Kilograms, kg

c Metres per second, m s^{-1}

d Metres per second squared, m s^{-2}

2 Convert

a 8.5 km to m **b** 2.3 m to mm

c 482 cm to m **d** 1650 m to km

e $72\ \text{km h}^{-1}$ to m s^{-1} **f** $14\ \text{m s}^{-1}$ to km h^{-1}

g $25\ \text{cm s}^{-1}$ to km h^{-1} **h** $2.4\ \text{m}^2$ to cm^2

i 1.4 kg to g **j** 1.6 tonnes to kg

3 A car travels 70 km in 35 minutes. Evaluate its speed in

a km h^{-1} **b** m s^{-1}

4 Work out the distance, in km, travelled in a quarter of an hour by a car that has a constant speed of $20\ \text{m s}^{-1}$

5 A particle has an acceleration of $200\ \text{km h}^{-2}$ Express this in m s^{-2}

6 The force F (in N) on an object is related to its mass m (in kg) and its acceleration a (in m s^{-2}) by $F = ma$. Work out, in kg, the mass of an object if a force of 0.25 kN (kilonewtons) accelerates it at $20\ \text{km min}^{-2}$

Exercise 7.1B

1 A runner travels 3900 m at $8\ \text{km h}^{-1}$ Find, in minutes, the time she takes.

2 In the formula $s = ut + \frac{1}{2}at^2$, u is velocity, a is acceleration, t is time and s is displacement. Find the value of s if $u = 4\ \text{km h}^{-1}$, $a = 0.01\ \text{m s}^{-2}$ and $t = 40$ minutes. Give your answer in km.

3 A station platform is 180 m long. A train of length 120 m passes it at $30\ \text{km h}^{-1}$ How long will it take for the train to pass completely?

Challenge

4 A liquid of density $1.2\ \text{g cm}^{-3}$ is flowing at $3\ \text{km h}^{-1}$ through a cylindrical pipe of radius 5 cm. Given that $\text{density} = \frac{\text{mass}}{\text{volume}}$, and that for a cylinder with radius r and height h its volume is given by $\pi r^2 h$, calculate the mass, in kg, of the liquid emerging from the pipe in 30 seconds.

Answers

Exercise 7.1A

1 **a** Force

b Mass

c Speed or velocity

d Acceleration

2a 8500 m

2b 2300 mm

2c 4.82 m

2d 1.65 km

2e $\frac{72\times1000}{3600}=20\text{ m s}^{-1}$

2f $\frac{14\times3600}{1000}=50.4\text{ km h}^{-1}$

2g $\frac{25\times3600}{100000}=0.9\text{ km h}^{-1}$

2h 24000 cm^2

2i 1400 g

2j 1600 kg

3a $70\div\frac{35}{60}=120\text{ km h}^{-1}$

3b $\frac{120\times1000}{3600}=33.3\text{ m s}^{-1}$ (to 3 sf)

4 $15\text{ min}=900\text{ s}$

Travels $20\times900=18\,000\text{ m}$

$=18\text{ km}$

5 $200\text{ km h}^{-2}=200\,000\text{ m h}^{-2}$

$=\frac{200\,000}{3600^2}\text{ m s}^{-2}$

$=0.0154\text{ m s}^{-2}$

6 $0.25\text{ kN}=250\text{ N}$

$20\text{ km min}^{-2}=\frac{20\,000}{60^2}$

$=\frac{50}{9}\text{ m s}^{-2}$

From $F=ma$

$250=\frac{50m}{9}$

$\Rightarrow m=45\text{ kg}$

Exercise 7.1B

1 3.9 km at 8 km h^{-1} takes $\frac{3.9}{8}=0.4875\text{ h}$

$=60\times0.4875\text{ min}$

$=29\text{ min}$ (to 2 sf)

2 $u=\frac{4\times1000}{3600}$

$=\frac{10}{9}\text{ m s}^{-1}$

$t=40\times60$

$=2400\text{ s}$

$s=\frac{10}{9}\times2400+\frac{1}{2}\times0.01\times2400^2$

$=31\,466.7\text{ m}$

$=31.5\text{ km}$ (to 3 sf)

3 The front of the train is 120 m beyond the end of the platform before the train has completely passed.

So the train travels $180+120=300\text{ m}$

$30\text{ km h}^{-1}=\frac{30\times1000}{3600}$

$=\frac{25}{3}\text{ m s}^{-1}$

Time taken $=300\div\frac{25}{3}$

$=36\text{ s}$

4 $3\text{ km h}^{-1}=\frac{3000}{3600}$

$=\frac{5}{6}\text{ m s}^{-1}$

$1.2\text{ g cm}^{-3}=\frac{0.0012}{0.01^3}$

$=1200\text{ kg m}^{-3}$

Volume in 30 s $=\pi\times0.05^2\times\frac{5}{6}\times30$

$=0.196\text{ m}^3$

Mass $=1200\times0.196$

$=236\text{ kg}$ (to 3 sf)